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10/593,644	09/21/2006	Toshiyuki Mihara	060718	4916

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EXAMINER	
SALZMAN, KOURTNEY R	

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4128	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/593,644	MIHARA ET AL.	
	Examiner	Art Unit	
	KOURTNEY R. SALZMAN	4128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _21 September 2006_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-9_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-9_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _September 21, 2006, December 14, 2006_.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Summary

1. This is the initial Office Action based on the Thermoelectric Conversion Element and Thermoelectric Conversion Module application 10/593,644, filed on September 21, 2006, which claims priority from the Japanese application number 2004-088290 filed March 25, 2004. This is the national stage application of PCT/JP05/05133.

2. Claims 1-9 are pending and have been fully considered.

Priority

3. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. Claims 1, 3, 4, 6 and 7 are rejected under 35 U.S.C. 103(a) as being obvious over TAKAGI et al(US 4,443,650), in view of FUNAHASHI et al(US 6,376,763) and YOSHIMOTO et al(US 5,352,299).

TAKAGI et al teaches a thermoelectric converter element comprising p-type and n-type semiconductor films and a flexible insulating substrate (column 2, line 58 - column 3, line 8). These films are electrically connected as "one ends of the films are connected to each other or short circuited to each other".(column 2, lines 62-65) TAKAGI et al states, in column 3, lines 1-6, the films can be connected by a metallic layer or directly to one another through contact. Figures 4A and 4B show the films connected utilizing a metal layer, where the p-type and n-type layers are reference number 1 and 2 respectively. Both layers are shown as connected to the insulating substrate, reference number 6.

TAGAKI et al teaches the use of conventional thermoelectric films in column 8, line 61 – column 9, line 12. However, TAKAGI et al fails to teach the composition of the p-type and n-type layers are complex oxides.

FUNAHASHI et al teaches a p-type semiconductor made of complex oxide as disclosed in the instant application. The complex oxide is shown in the abstract to have the formula $Ca_{3-x}RE_xCo_4O_y$, where the ranges of the variables are $0 \leq x \leq .5$ and $8.5 \leq y \leq 10$. Using these ranges, the subscript of the calcium molecule can occupy the range 2.5 - 3. RE represents the use of a rare earth molecule stated to be any of elements, "Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb

and Lu”, listed in column 2, lines 53-55, which includes the lanthanide series. The rare earth subscript can range from 0-.5. The oxygen molecule has the subscript ascribed by the y variable. All the subscript ranges and possible element selections listed are contained within the limitations of claim 1, formula 1. The A^2 element is not required to be present in formula 1 because subscript zero falls within the range designated for variable d of the instant application.

At the time of invention, it would be obvious to construct the p-type semiconductor described in TAKAGI et al of the complex oxide material of FUNAHASHI et al because this composition allows for optimized features of the thermoelectric device. FUNAHASHI et al states in the abstract that the use of this oxide which is composed of "low-toxicity elements, excellent in heat resistance and chemical durability and high in thermoelectric conversion efficiency." These are all highly desirable traits in a thermoelectric device. Therefore, the use of the material described in FUNAHASHI et al in the structure of TAKAGI et al is obvious because it improves the functional properties of the thermoelectric device, an obvious goal of the thermoelectric industry.

TAKAGI et al and FUNAHASHI et al fail to disclose the n-type layer made of complex oxides.

YOSHIMOTO et al teaches an n-type semiconductor film as in the instant application. The complex oxide is shown in the abstract to have the formula (Ln_{1-}

$_xA_x)_2MO_4$, and is further discussed in great detail in column 2, lines 5-26. The subscripts of each reference variable x which is stated to be in the range of $0.01 \leq x \leq .05$. The Ln stated to be a rare earth element, which in column 2, lines 15-18, is to be one of the group of "yttrium (Y), lanthanum (La), dysprosium (Dy), ytterbium (Yb), and samarium (Sm)". The rare earth element can then as a subscript, per YOSHIMOTO et al, be present in the compound between .95-.99. The formula element A is stated to be an alkaline earth metal, which in column 2, lines 19-21, is to be one of the group of “calcium (Ca), strontium (Sr) and barium (Ba)" and can be present in quantities ranging from subscripts .01 - .05. The formula element M is stated to be a transition metal element, which in column 2, lines 22-26, is to be one of the group of "copper (Cu), titanium (Ti), iron (Fe), nickel (Ni), zinc (Zn), cobalt (Co), and manganese (Mn)". Here the choice of nickel as the transitional metal creates a compound which corresponds directly to that described in claim 1, formula 4. All the subscript ranges and possible element selections listed are contained within the limitations of claim 1, formula 4. The R^4 element is not required to be present in formula 4 because subscript zero falls within the range designated for variable v of the instant application.

At the time of invention, it would be obvious to combine the thermoelectric device of TAKAGI et al modified by the p-type thermoelectric material of FUNAHASHI et al with the addition of a complex oxide n-type thermoelectric material of YOSHIMOTO et al because this composition allows for optimized features of the thermoelectric device. In column 2, lines 40-54 of YOSHIMOTO

et al, numerous benefits are outlined for low temperature operation, while the advantages of production at a low cost and easy controllability appeal to the entire thermoelectric industry. Therefore, it would be obvious to one of ordinary skill in the art to combine the thermoelectric structure of TAKAGI et al modified to include the p-type thermoelectric material of FUNAHASHI et al with the n-type thermoelectric material of YOSHIMOTO et al because the n-type material provides for low cost, highly controlled operation.

Regarding claim 2, in conjunction with the previous rejection of claim 1, the p-type thermoelectric material as described in FUNAHASHI et al and discussed in the rejection of claim 1, is applicable to this material designation. The description and rejection of the n-type thermoelectric material described in YOSHIMOTO et al and the rejection of claim 1, is also applicable to the rejection of claim 2 as well.

Regarding claim 3, in conjunction with the previous rejection of claim 1, TAKAGI et al teaches, in column 3, lines 1-9, multiple ways to connect the two conductive films. The first is described as “one ends of the films may be connected to each other through a metallic layer". The second is described as, “one ends of the films may be directly connected to each other by being overlaid one above the other”. Both correspond to possible electrical connections describe in the instant application.

Regarding claim 4, in conjunction with the previous rejection of claim 1, TAKAGI et al shows in figures 4A and 4B, as discusses in column 8, lines 3-4, that the n-type and p-type, reference numbers 1 and 2 respectively, are formed on the substrate, shown as reference number 6. They are shown to be on the same surface of the substrate.

Regarding claim 6, in conjunction with this previous rejection of claim 1, FUNAHASHI et al states in column 2, lines 47-48, the complex oxide as described has "a Seebeck coefficient of 100 μV/k or more at a temperature of 300°C or higher". The Seebeck coefficient is a measure of thermoelectric force. A temperature of 300°C is equivalent to a temperature of 573K, covering within the range described in the instant claim.

Regarding claim 7, in conjunction with the previous rejection of claim 1, the combination of the structure of TAKAGI et al with the thermoelectric materials described in FUNAHASHI et al and YOSHIMOTO et al, yield a substantially similar structure and material to that described in the instant application. Therefore, the thermoelectric element would have the same electrical resistive properties, including an electrical resistance of 1kΩ or lower in a temperature range of 293K to 1073K. (MPEP 2112)

7. Claims 5, 8 and 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over TAKAGI et al(US 4,443,650), FUNAHASHI et al(US 6,376,763) and YOSHIMOTO et

al(US 5,352,299) as applied to claim 1 above, and further in view of BUIST (US 4,859,250).

TAKAGI et al, FUNAHASHI et al and YOSHIMOTO et al teach all the limitations of claim 1.

The combination of the structure of TAKAGI et al with the materials described in FUNAHASHI et al and YOSHIMOTO et al fails to teach possible materials for the insulating substrate and how the thermoelectric elements attach together.

BUIST teaches the use of a thermoelectric device within a heat pump or power source device which places the n-type or p-type semiconductors on flexible or inflexible substrates. In the abstract, BUIST states, "the film type elements are formed on substrates of such flexible, electrically insulation material, as, for example MYLAR and TEFLON; while for inflexible unites the elements are formed on substrates of such materials as... plastics." MYLAR and TEFLON are trade names of polymers considered to be plastics.

It would be obvious to one of ordinary skill in the art to combine the semiconductor structure and materials of TAKAGI et al, FUNAHASHI et al and YOSHIMOTO et al with the plastic substrate of BUIST because there are only a finite number of insulating materials for use as the thermoelectric substrate. Plastics are a principle component of a group of any insulating materials. Thus, it would have been obvious to one of ordinary skill in the art to use the plastic

substrate of BUIST as the insulating substrate material as described in TAKAGI et al, FUNAHASHI et al and YOSHIMOTO et al, as a person with ordinary skill has good reason to pursue the known options within his or her technical grasp. In turn, because the use of plastic as the substrate has the insulating properties of predicted by the combination of TAKAGI et al, FUNAHASHI et al and YOSHIMOTO et al, it would have been obvious to use plastic in the thermoelectric element.

Regarding claim 8, in conjunction with the previous rejection of claim 1, BUIST teaches in figure 3A the location and connection of p-type and n-type semiconductors. The thermoelectric element includes the n-type conductor (reference number 64), p-type conductor (reference number 66) and connection between the two (reference number 82). Each element is shown connected in series. The unconnected end of the p-type semiconductor is electrically connected to the unconnected end of the n-type semiconductor using lead, reference number 80. This is method of connection is conventional to one of ordinary skill in this art. Therefore, the connection of an n-type and p-type semiconductor via an unconnected end would be obvious.

Regarding claim 9, in conjunction with the previous rejections of claims 1 and 8, BUIST utilizes the configuration of thermoelectric elements, as in the rejection of claim 8, shown in figure 3A, and forms the elements into strips affixed to the flexible plastic substrate. In column 5, lines 5-8, BUIST teaches, “the

thermoelectric elements are folded to combine all cold strings on a first plane and all hot strips on a second plant opposing the first plane of cold strips". Shown in figure 4, the hot side is compiled on one end of the modulus, while the cold side s complied opposite.

At the time of invention, one of ordinary skill in the art would find it obvious to organize the structure and materials of TAGAKI et al, FUNAHASHI et al and YOSHIMOTO et al in the manner of BUIST because the layout of similar temperature elements on opposing sides is obvious. It is intuitive to place the cold strip elements on one side of the thermoelectric modulus and the hot elements on the other because a thermoelectric device is usually used to generate power from a temperature gradient on two different sides of the device. The organization of the elements taught by TAGAKI et al, FUNAHASHI et al and YOSHIMOTO et al in the pattern of BUIST is obvious as it allows the thermoelectric device to function efficiently.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to KOURTNEY R. SALZMAN whose telephone number is (571)270-5117. The examiner can normally be reached on Monday to Friday 7AM to 4PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Barbara Gilliam can be reached on (571) 272-1330. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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krs